Digestive System

Lecture 19
Chapter 15
I. Function

II. Layers of the GI tract

III. Major parts: mouth, pharynx, esophagus, stomach, small intestine, large intestine, pancreas, liver, gall bladder.

IV. Digestive enzymes

V. Disorders of the digestive system
The Digestive System

- The digestive system consists of a long tube, called the gastrointestinal (GI) tract that extends from the mouth to the anus, along with accessory glands.

- The digestive system is divided into specialized compartments for food processing.

- Nerves and hormones control digestive activities.
The function of the digestive system is to:

1. bring food into the body
2. digest it into nutrients that are absorbed by the body
3. eliminate wastes out of the body.
**Terminology**

- **Digestion**: The process of breaking complex molecules into simpler molecules which can be **absorbed** in the GI tract.

- **Absorption**: The process of transporting molecules across the wall of the GI tract into vessels to be transported to the liver.
Digestion

- **Mechanical digestion** - chewing of food, churning action of the stomach, and segmentation of the small intestine.

- **Chemical digestion** - action of enzymes and chemicals on foods.
The Digestive System

**Organs**

**Mouth**
- Entrance to digestive system
- Teeth chew food
- Tongue positions and tastes food

**Pharynx**
- Passageway for food (and air)
- Plays a role in swallowing

**Esophagus**
- Muscular tube
- Moves food from pharynx to stomach

**Stomach**
- J-shaped muscular sac
- Stores food
- Secretes gastric juice (pepsin and HCl)
- Mixes food with gastric juice
- Protein digestion begins

**Small intestine**
- Long, muscular tube
- Mixes food with bile and with intestinal and pancreatic enzymes
- Digests most nutrients
- Absorbs most nutrients and water

**Colon**
- Muscular tube
- Absorbs water and some nutrients
- Stores waste materials (feces)

**Rectum**
- Region of large intestine
- Passageway for feces
- Stretching of wall stimulates the defecation reflex

**Anal canal**
- Regulates defecation

**Large intestine**
- Cecum
  - Blind pouch at junction of small and large intestines

**Anus**
- Opening at end of system
- Expels feces

**Figure 15.1 (1 of 2)**
Salivary glands
- Three pairs of glands that secrete saliva
- Saliva moistens food
- Enzyme (amylase) in saliva begins starch digestion

Pancreas
- Gland located behind stomach
- Secretes enzymes that digest all major nutrients
- Secretes buffers that neutralize HCl from stomach
- Releases secretions into small intestine

Liver
- Large organ in abdominal cavity
- Secretes bile, which emulsifies fats
- Plays role in processing and storing certain nutrients

Gallbladder
- Small sac
- Stores bile
- Releases bile into small intestine
What type of epithelial tissue lines the GI tract?

1. Simple cuboidal
2. Simple squamous
3. Simple columnar
4. Stratified squamous
Wall of the Digestive Tract

- Along most of its length, the wall of the digestive system has four basic layers

1. Mucosa
2. Submucosa
3. Muscularis
4. Serosa
The **mucosa** is a mucous membrane that lines the GI tract and secretes mucus that lubricates and protects the GI tract.

The **submucosa** is a layer of connective tissue that contains blood vessels, lymph vessels, and nerves.

The **muscularis** is made up of two layers of smooth muscle—one circular and one longitudinal.

The **serosa** is a connective tissue covering that secretes a fluid to lubricate the outside of the GI tract.
Wall of the Digestive Tract - Mucosa

- **Mucosa** - Mucus membrane layer lines the GI tract
  - The open area inside the GI tract is the **lumen**.
  - Glandular epithelial cells secrete digestive enzymes.
  - Goblet cells secrete mucus, which lubricates.
  - Simple columnar epithelial cells line the lumen
Wall of the Digestive Tract - Submucosa

- **Submucosa** – layer of connective tissue with nerves, blood supply, lymph vessels.

- Protect us from disease, nerves stimulate muscles, transport of nutrients.
Wall of the Digestive Tract - Muscularis

- **Muscularis** – Layer of smooth muscles.

- Has two layers of muscle, one circular and one longitudinal

- Functions to mix and moves food.
Wall of the Digestive Tract - Serosa

- **Serosa** – a layer covering the GI tract that secretes serous fluid.

- The fluid functions to reduce friction between moving layers of tissue.
Components of the GI Tract

- The major GI Tract components
  - Mouth
  - Esophagus
  - Stomach
  - Small intestine
  - Large intestine
Accessory Organs

- The digestive organs are aided by several accessory organs
  - Salivary glands
  - Pancreas
  - Gallbladder
  - Liver
The Digestive System Has Specialized Compartments

**TABLE 15.1 Review of Structures of the Digestive System**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description/Functions</th>
<th>Mechanical Digestion</th>
<th>Chemical Digestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth</td>
<td>Receives food; contains teeth and tongue; tongue manipulates food and monitors quality</td>
<td>Teeth tear and crush food into smaller pieces</td>
<td>Digestion of carbohydrates begins</td>
</tr>
<tr>
<td>Pharynx</td>
<td>Area that both food and air pass through</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Tube that transports food from mouth to stomach</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Stomach</td>
<td>J-shaped muscular sac for food storage</td>
<td>Churning of stomach mixes food with gastric juice, creating liquid chyme</td>
<td>Protein digestion begins</td>
</tr>
<tr>
<td>Small intestine</td>
<td>Long tube where digestion is completed and nutrients are absorbed</td>
<td>Segmental contractions mix food with intestinal enzymes, pancreatic enzymes, and bile</td>
<td>Carbohydrate, protein, and fat digestion completed</td>
</tr>
<tr>
<td>Large intestine</td>
<td>Final tubular region of GI tract; absorbs water and ions; houses bacteria; forms and expels feces</td>
<td>None</td>
<td>Some digestion is carried out by bacteria</td>
</tr>
<tr>
<td>Anus</td>
<td>Terminal outlet of digestive tract</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Parts of the Digestive Tract - Mouth

1. **Mouth**: specialized for tasting, speech, moistening food, and mechanical and enzymatic digestion.
The mouth contains:

1. **Salivary glands** - secretes **salivary amylase** that begins the process of digesting **starch**.
2. **Tongue** - mixes chewed food with saliva.
3. **Teeth** – break food into smaller pieces
4. **Tonsils** – protect against infections
5. **Uvula** – working with the soft palate, closes off the nasopharynx
Saliva:

- Moistens food
- Dissolves the chemicals in the food
- Contains the enzyme, salivary amylase
  - Begins digestion of carbohydrates
Salivary glands

- Parotid gland
- Sublingual gland
- Submandibular gland
Mouth - Tongue

- The tongue
  - A large skeletal muscle with taste buds
  - Important in speech
  - Helps form food into a **bolus**
    - A soft mass of food, suitable for swallowing
(b) The structure of the human tooth is suited for its function of breaking food into smaller pieces.
2. **Pharynx**: behind the uvula where the nasal and oral cavities join. Common passageway for air, liquids, and food.

- Swallowing reflex begins here.

- **Epiglottis** covers opening in the larynx that leads to the trachea when swallowing.
3. **Esophagus** – passage that connects the pharynx to the stomach.

- No digestive processes occur here
Food is pushed through our digestive system by a series of muscular contractions called peristalsis.
Figure 15.7

Esophagus

Waves of contraction

Bolus

Stomach
Esophagus

- **Sphincters** - circular muscles that control the entrance and exit of materials to and from the stomach.

- **Acid reflux** - heartburn occurs when partially digested food comes back up into the esophagus and produces a burning sensation.
4. Stomach

- The stomach breaks up food through muscular contractions. There are **three layers of smooth muscle**

- The food that leaves the stomach is only partially digested.
(a) The stomach wall has three layers of smooth muscle, each oriented in a different direction, that allow the stomach to churn and mix food with digestive secretions.
4. Stomach functions

- The functions of the stomach include:
  1. Responsible for the storage of food
  2. Turns food into a soupy mixture called chyme
  3. Adds digestive enzymes and acids that begin chemical digestion of proteins
The stomach expands to accommodate amounts of food

- When empty the stomach can hold about 50 ml (1/4 cup)
- When full, can hold several liters of food
The thick soupy acidic liquid that leaves the stomach is called:

1. chylomicrons
2. bolus
3. chyme
4. feces
Stomach – Secretions

- Gastric glands secrete:
  1. The digestive enzyme, **pepsin**, that begins the digestion of proteins.
  2. Hydrochloric acid (HCl) - strong acid that kills bacteria, aids in the digestion of proteins, begins to break down connective tissues, and activates pepsin.

- The wall of the stomach is protected by a thick layer of mucus secreted by goblet cells.
Stomach - Storage of Food

- Very little nutrition is actually absorbed into the blood stream from the stomach.

- Exceptions include alcohol and some drugs including aspirin
(b) Gastric glands in the wall of the stomach produce gastric juice, a mixture of hydrochloric acid and pepsin.
(c) The holes seen in this electron micrograph are the gastric pits, openings in the stomach wall through which gastric glands release their secretions.
How many layers of smooth muscle are in the wall of the stomach?

1. One
2. Two
3. Three
4. Four
What is the muscular tube that passes foodstuffs from the pharynx to the stomach?

1. Trachea
2. Larynx
3. Esophagus
4. Small intestine
The primary function of the stomach is:

1. to break down fats
2. to store food, liquefy, begin digestion
3. to absorb major nutrients
4. package feces
duodenum: receives chyme from stomach and secretions from pancreas and liver

jejunum: region of most digestion and nutrient absorption

ileum: absorption continues

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5. The Small Intestine

- Small intestine – thin long tube (2.5 cm in diameter and about 6 meters long.

- Secretions from the pancreas, liver and gall bladder enter the small intestine

- Smooth muscles surround the intestine to push the food through the digestive tract.
The small intestine has three regions:

1. Duodenum
2. Jejunum
3. Ileum
Function of the Small Intestine

1. This is the primary site of digestion (mainly chemical, but also mechanical)

2. Where most (80%) of the nutrients are absorbed into the body.
Digestion in the Small Intestine

- The digestion of complex molecules (carbohydrates, proteins, fats, and nucleic acids) in the small intestine is aided by:
  1. enzymes released from the pancreas and the small intestine
  2. and by bile from the gall bladder
Small Intestine Structure

- The lining of the small intestine is
  - Pleated (has folds)
  - The pleats have numerous finger-like projections called villi to increase surface area
Small Intestine

Figure 15.9a

(a) Circular folds
Small Intestine - Villi

(b) Intestinal gland
Blood vessels
Lymphatic vessel

Villi
Mucosa
Submucosa

Figure 15.9b–c
**Small Intestine Structure - Villi**

- **Villi** (villus, singular) - greatly increase the absorption area of the small intestine.

- Villi contain blood capillaries and lymphatic vessels called lacteals
  - **Lacteals** — absorb fatty acids.
  - **Blood capillaries** — absorb nutrients including glucose and amino acids.
Absorption

- Absorption – once complex molecules are broken down into smaller molecules, they are transported across the intestine wall.

- Each villus contains a network of capillaries and a lacteal
Microvilli

- Each villus is covered with **microvilli**
  - Gives the small intestine a velvety appearance, increases the surface area
- Called the **brush border**
6. Large Intestine

- By the time the food enters the large intestine most of the nutrients have been removed.
Large Intestine - Functions

1. Water, salts, & vitamins are absorbed from the large intestine, adjusting the consistency of the waste material, feces.

2. The feces are stored

3. The feces is excreted from the body
Large Intestine

- Ascending colon
- Transverse colon
- Descending colon
- Cecum
- Appendix
- Rectum
- Anal canal
- External anal sphincter
- Small intestine
Components of the Large Intestine

- **Cecum** - lies below the junction with the small intestine.

- **Appendix** – slender pouch extending from cecum, may play a role in fighting infections but may become inflamed.
Components of the Large Intestine

- **Colon** – largest portion of the large intestine
  - absorbs much of the remaining water, and sodium and potassium ions
  - Contains beneficial bacteria which act on indigestible material (causing gas), produce B complex vitamins, and most of the vitamin K needed for clotting of blood.
  - The undigested food residue that leaves the colon is called **feces**
Components of the Large Intestine

- **Rectum** - holds feces temporarily and opens into the anus.

- **Anus** – has sphincter muscles controls defecation (reflex action).
Nutrients are primarily absorbed in the:

1. Stomach
2. Small Intestine
3. Large Intestine
The liver produces bile, which is stored in the gallbladder before being released into the small intestine.

The pancreas produces several digestive enzymes that act in the small intestine.
Pancreas

- The pancreas releases secretions into the small intestine to aid in digestion

- The pancreas is also a gland that releases hormones
Pancreas - Functions

1. Produces the hormones into the bloodstream which regulate glucose levels.

2. Secretes digestive enzymes into the small intestine.

3. Secretes bicarbonate ions into the small intestine to neutralize the acid in the chyme
Pancreas - Hormones

- The pancreas secretes two hormones into the blood to regulate glucose levels:

  1. Insulin - decreases blood glucose levels.
  2. Glucagon - increases blood glucose levels.
Pancreas – Digestive Enzymes

- The pancreas produce and release three enzymes into the small intestine:

1. Pancreatic amylase - digests starch.
2. Trypsin - digests proteins.
3. Lipase - digests fats.
Liver

- Blood from capillaries of the intestine, carrying nutrients, goes to the liver through the hepatic portal veins.
Step 1: Products of digestion are absorbed into the capillaries within the villi of the small intestine.

Step 2: Digested food molecules then travel through hepatic portal veins to the liver.

Step 3: The liver monitors blood contents.

Step 4: Hepatic veins deliver blood to the circulatory system.
Liver functions - digestion

1. Produces Bile
2. Processes (metabolizes) nutrients from the GI tract.
3. Metabolizes drugs and toxins
   - The liver has many enzymes that help the body metabolize.
More Liver Functions

4. Produces plasma proteins.
5. Breaks old blood cells down, producing bilirubin.
7. Stores iron and fat soluble vitamins A, D, E, K, and B_{12}.
8. Stores glucose as glycogen.
9. Regulates the quantity of cholesterol in the blood.
Liver - Bile

- The liver produces bile which helps to break down fats.
Accessory Organs - Gallbladder

- Gall bladder - stores excess bile. Bile emulsifies fat
Digestive Enzymes

- **Digestive enzymes** - break down macromolecules into smaller molecules.

- See page 301, Table 15.2
## TABLE 15.2 Major Digestive Enzymes

<table>
<thead>
<tr>
<th>Site of Production</th>
<th>Enzyme</th>
<th>Site of Action</th>
<th>Substrate and Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salivary glands</td>
<td>Salivary amylase</td>
<td>Mouth</td>
<td>Polysaccharides into shorter molecules</td>
</tr>
<tr>
<td>Stomach</td>
<td>Pepsin</td>
<td>Stomach</td>
<td>Proteins into protein fragments (polypeptides)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Trypsin</td>
<td>Small intestine</td>
<td>Proteins and polypeptides into smaller fragments</td>
</tr>
<tr>
<td></td>
<td>Chymotrypsin</td>
<td>Small intestine</td>
<td>Proteins and polypeptides into smaller fragments</td>
</tr>
<tr>
<td></td>
<td>Amylase</td>
<td>Small intestine</td>
<td>Polysaccharides into disaccharides</td>
</tr>
<tr>
<td></td>
<td>Carboxypeptidase</td>
<td>Small intestine</td>
<td>Polypeptides into amino acids</td>
</tr>
<tr>
<td></td>
<td>Lipase</td>
<td>Small intestine</td>
<td>Triglycerides (fats) into fatty acids and glycerol</td>
</tr>
<tr>
<td></td>
<td>Nucleases (deoxyribonuclease and ribonuclease)</td>
<td>Small intestine</td>
<td>DNA or RNA into nucleotides</td>
</tr>
<tr>
<td>Small intestine</td>
<td>Maltase</td>
<td>Small intestine</td>
<td>Maltose into glucose units</td>
</tr>
<tr>
<td></td>
<td>Sucrase</td>
<td>Small intestine</td>
<td>Sucrose into glucose and fructose</td>
</tr>
<tr>
<td></td>
<td>Lactase</td>
<td>Small intestine</td>
<td>Lactose into glucose and galactose</td>
</tr>
<tr>
<td></td>
<td>Aminopeptidase</td>
<td>Small intestine</td>
<td>Peptides into amino acids</td>
</tr>
</tbody>
</table>

Table 15.2
What is the monomer unit of starch?

1. Amino acids
2. Fatty acids
3. Glucose
4. Glycerol
Carbohydrate Digestion - Amylase

- Secreted by:
  - the salivary glands in the mouth
  - and by the pancreas.

- Site of action: Mouth, small intestine

- Function: breaks down starch into maltose (a disaccharide)
Carbohydrate Digestion - Maltase

- Secreted by: the small intestine

- Site of action: Small intestine

- Function: breaks down maltose into glucose

- Glucose is then absorbed by capillaries
Carbohydrate Digestion

(a) Carbohydrate digestion

Polysaccharide → Disaccharide → Monosaccharide → Glucose → Fructose → Capillary → To liver
What is the monomer unit of proteins?

1. Amino acids
2. Fatty acids
3. Glucose
4. Glycerol
Protein Digestion

- Pepsin
- Trypsin
- Chymotrypsin
- Pepsidases
Protein Digestion - Pepsin

- Secreted by the stomach
- Site of action: Stomach
- Function: Breaks proteins and polypeptides into smaller pieces
Protein Digestion - Trypsin

- Secreted by the pancreas
- Site of action: Small intestine
- Function: breaks proteins and polypeptides into smaller pieces
Protein Digestion - Chymotrypsin

- Secreted by the pancreas
- Site of action: Small intestine
- Function: breaks proteins and polypeptides into smaller pieces
Protein Digestion - Peptidases

- Secreted by:
  - the small intestine - carboxypeptidase
  - and the pancreas - aminopeptidase

- Site of action: Small intestine

- Function: breaks proteins and polypeptides into amino acids

- Amino acids are absorbed by capillaries
Protein Digestion

(b) Protein digestion
What is the monomer unit of DNA and RNA?

1. Amino acids
2. Fatty acids
3. Glucose
4. Nucleotides
Nucleic Acid Digestion - Nucleases

- Secreted by: Pancreas
- Site of action: Small intestine
- Function: breaks nucleic acids (DNA and RNA) into nucleotides
- Nucleotides are absorbed by capillaries
Bile is produced by:

1. Pancreas
2. Gall Bladder
3. Liver
4. Small Intestine
Digestion of Fats

- Bile
- Lipase
Digestion of Fats - Bile

- Bile is produced by the liver, stored in the gallbladder
- Site of action: Small intestine
- Function: Emulsifies fat droplets into smaller droplets = emulsification
Digestion of Fats - Lipase

- Secreted by the pancreas
- Site of action: Small intestine
- Function: Breaks triglycerides into monoglycerides
Digestion of Fats - Absorption

- Monoglycerides combine with bile salts to form micelles.
- Micelles are absorbed into the epithelial lining of the small intestine.
Digestion of Fats - Absorption

- Inside the epithelial cells, the monoglycerides combine into triglycerides and join with cholesterol, proteins and phospholipids to form **chylomicrons**

- The **chylomicrons** are absorbed by the lacteals
Fat Digestion

(c) Fat digestion

Figure 15.10c
The digestive enzyme responsible for fat digestion is:

1. Pepsin
2. Pepsidase
3. Lipase
4. Bile
Lipase is secreted from

1. Small intestine
2. Stomach
3. Pancreas
4. Large intestine
<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Produced by</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amylase</td>
<td>salivary glands, pancreas</td>
<td>breaks down starch to maltose</td>
</tr>
<tr>
<td>Maltase</td>
<td>small intestine</td>
<td>breaks down maltose to glucose</td>
</tr>
<tr>
<td>Pepsin</td>
<td>stomach</td>
<td>breaks proteins into smaller pieces</td>
</tr>
<tr>
<td>Trypsin</td>
<td>pancreas</td>
<td>breaks proteins into smaller pieces</td>
</tr>
<tr>
<td>Peptidases</td>
<td>small intestine and pancreas</td>
<td>breaks proteins and polypeptides into amino acids</td>
</tr>
<tr>
<td>Nucleases</td>
<td>Pancreas</td>
<td>Breaks nucleic acids into nucleotides</td>
</tr>
<tr>
<td>Lipase</td>
<td>pancreas</td>
<td>digests fat molecules into monoglyceride fatty acids</td>
</tr>
</tbody>
</table>
Control of Digestive Secretions

- Control of digestive secretions is controlled by **hormones** and **nerves**.
Control of Digestive Secretions

- Release of saliva is controlled by **nerves**

- The chewing of food stimulates **nerves** that control the stomach, causing it to begin to release gastric secretions.
Control of Digestive Secretions

- The stretching of the stomach causes the stomach to release the hormone gastrin.

- Gastrin circulates in bloodstream and stimulates the stomach to release more gastric secretions
Control of Digestive Secretions

- The presence of acidic chyme entering the small intestine triggers nerves that stimulate:
  1. pancreas to release digestive enzymes
  2. small intestine to release digestive enzymes
  3. gall bladder to release bile
  4. small intestine to release hormones
Control of Digestive Secretions

- The small intestine releases hormones:
  - Vasoactive intestinal peptide – stimulates the small intestine to release enzymes
  - Secrin – stimulates the pancreas to release a buffer
  - Cholecystokinin – causes the pancreas to release digestive enzymes and the gall bladder to release bile
Which will be better if you need a quick response:

1. Hormones
2. Nerves
# Nerves and Hormones Control Digestive Activities

## Table 15.4 Examples of Neural Controls on Digestive Activity

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sight of food, thought of food, presence of food in mouth</td>
<td>Release of saliva from salivary glands</td>
</tr>
<tr>
<td>Chewing food</td>
<td>Release of gastric juice (enzymes from stomach and HCl) and mucus from cells of stomach lining</td>
</tr>
<tr>
<td>Presence of acidic chyme in small intestine</td>
<td>Release of enzymes from small intestine and pancreas into the small intestine; release of bile from gallbladder into small intestine; increased motility in small intestine</td>
</tr>
</tbody>
</table>
## Nerves and Hormones Control Digestive Activities

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Stimulus</th>
<th>Origin</th>
<th>Target</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrin</td>
<td>Distention of stomach by food; presence of partially digested proteins in stomach</td>
<td>Stomach</td>
<td>Stomach</td>
<td>Release of gastric juice (enzymes from stomach and HCl)</td>
</tr>
<tr>
<td>Vasoactive intestinal peptide</td>
<td>Presence of acidic chyme in small intestine</td>
<td>Small intestine</td>
<td>Small intestine</td>
<td>Release of enzymes from small intestine</td>
</tr>
<tr>
<td>Secretin</td>
<td>Presence of acidic chyme in small intestine</td>
<td>Small intestine</td>
<td>Pancreas</td>
<td>Release of sodium bicarbonate from pancreas into small intestine to neutralize acidic chyme</td>
</tr>
<tr>
<td>Cholecystokinin</td>
<td>Arrival of chyme-containing lipids</td>
<td>Small intestine</td>
<td>Pancreas, Gall bladder</td>
<td>Release of enzymes from pancreas, Contraction of gallbladder and release of bile</td>
</tr>
</tbody>
</table>
Stomach Disorders - Ulcers

- **Ulcer** - Open sore often found in the stomach.

- **Causes:**
  - Most are caused by a bacterial infection (*Helicobacter pylori*) that impairs the ability of the epithelial cells to produce protective mucus
  - Also maybe caused by pain relievers, alcohol, smoking and stress

- **Symptoms:** burning sensation in stomach

- **Treatment:** antibiotics if caused by bacteria
Acid reflux - heartburn occurs when partially digested food comes back up into the esophagus and produces a burning sensation.

Can be caused by alcohol consumption, may lead to esophageal ulcers.
Liver Disorders - Hepatitis

- Hepatitis - inflammation of the liver

- Caused by five types of hepatitis viruses (A-E):
  - Hep. A - usually acquired from sewage-contaminated drinking water (vaccine available)
  - Hep. B - usually spread by sexual contact. (vaccine available)
  - Hep C - usually acquired by contact with infected blood. (no vaccine)

- Effect: liver can not process bilirubin, leads to Jaundice, HBV form can lead to cancer.
Liver Disorders - Cirrhosis

- Cirrhosis - the liver becomes fatty and is eventually replaced by scar tissue. Usually due to excessive drinking of alcohol
Disorders of the Gallbladder

- Gall stones – When the cholesterol content of bile comes out of solution and form crystals

- Obstructive jaundice - gall stones may block the common bile duct and cause pain then the gall bladder must be removed.
Large Intestine - Disorders

- **Diarrhea** – Material passes through the large intestine too quickly and not enough water is removed. Can lead to dehydration.

- **Constipation** – Material does not move quickly enough and too much water is removed.
Diverticulosis – when pouches form in the wall of the large intestine, called diverticula.

When they get infected and inflamed it is called diverticulitis.
Polyps - small growths from the epithelial lining.

- Fiber in the diet decreases the growth of polyps, fats increase the growth.

- Polyps can develop into colon cancer.
Important Concepts

- Read Ch 16

- What is the purpose of the digestive system?

- What are the layers of the GI tract and be able to describe the layers and what are the functions of the layers?

- What are the parts of the mouth and their functions?
Important Concepts

- What are the major parts of the digestive system and their functions. Be able to describe the parts of the digestive system (mouth, pharynx, esophagus, stomach, small intestine, large intestine, pancreas, liver, gall bladder)

- What are the three regions of the small intestine, what is their order (food passes through it in what order)
Important Concepts

- How is food absorbed in the small intestine? How are fats absorbed versus other nutrients. What is the structure of villi, what is the role of blood capillaries and lacteals. What is the role of bile and lipase in fat digestion.

- What type of muscle is found in the wall of the GI tract, how many layers are in the stomach and the in the rest of the GI tract. What is the function of these muscles
Important Concepts

- What are the components of the large intestine and their functions?
- What is the function of bile?
- What do pancreatic secretions contain, and what are their functions?
- What are the digestive enzymes, and chemical secretions (bile and acid) what are their specific functions, and where they are secreted from and where is their site of action.
Important Concepts

- Be able to describe in detail how the digestive secretions are controlled, which are controlled by nerves and which by hormone, what are the hormones that control the release of digestive secretions, where are these hormones produced and where is their site of action?

- What is the function of the acid secreted in the stomach
Important Concepts

- What is the function of the globlet cells.

- Be able to describe all the disorders of the digestive system, including the causes, effects and treatments
Definitions

- Gastrointestinal (GI) tract, digestion, absorption, mechanical, chemical digestion, lumen, peristalsis, chyme, bolus, sphincters, villi, microvilli, brush border, lacteals, bilirubin, goblet cells, emulsifies/emulsification, micelles, chylomicrons, feces, polyps, diverticula